

Intra-Articular Dislocation of the Patella With Associated Hoffa Fracture in a Skeletally Immature Patient

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Abstract

Since 1887, approximately 50 cases of an intra-articular patellar dislocation have been reported in the worldwide literature. The vast majority of patients required an open reduction of the patella or closed reduction under general anesthesia. This injury has never been reported in association with a coronal shear fracture of the femoral condyle.

A 14-year-old boy presented to our institution with his left knee locked in flexion after a direct blow. Radiographs showed the patella rotated on its horizontal axis and lying in a transverse position within the knee joint, as well as a concomitant femoral condyle fracture. After a successful closed reduction of the patella, the patient underwent open reduction and rigid fixation of the femoral condyle fracture with countersunk interfragmentary screws. At 12 months, the patient was ambulating on the left leg and had painless motion of the knee.

We present a rare injury pattern in a skeletally immature patient after a direct blow to the knee. By treating the injuries in a sequential manner and providing a stable fixation construct, the patient was able to achieve a satisfactory return to function even after sustaining a considerable injury to the knee.

In 1887, Midelfart¹ first reported on an intra-articular dislocation of the patella, and since then approximately 50 cases have been reported in the worldwide literature.² Also known as an inferior patellar dislocation, these rare traumatic events occur when the patella dislocates intra-articularly. Because the patella commonly rotates about its horizontal axis, the articular surface is facing proximally or distally. The patella becomes lodged within the trochlea and locks the knee joint. Most cases described in the literature involved adolescent boys, with the patella difficult to reduce. Most patients required open reduction, while those who underwent successful closed reduction often needed general anesthesia.³

Similarly, coronal shear fractures of the femoral condyle (ie, Hoffa fractures) are an uncommon fracture pattern typically seen in adults. These fractures are even more infrequent in skeletally immature patients, with fewer than 5 cases documented in the literature.⁴⁻⁷ In our case report, we present a 14-year-old boy with a coronal shear fracture of the femoral condyle associated with an intra-articular patellar dislocation. To our knowledge, this constellation of injuries has not been reported. Additionally, closed reduction of the patella was successful after intra-articular lidocaine injection, without the need for sedation or general anesthesia. The patient's guardian provided written informed consent for print and electronic publication of this case report.

Case Report

A 14-year-old boy presented to our institution after sustaining a direct blow to his left knee. The injury occurred as he jumped and landed on a flexed knee while playing with friends. The patient was unable to ambulate after the injury, and his left knee was locked in a slightly flexed position. Examination in the emergency department showed the knee to be held in approximately 60° of flexion, with an obvious bony prominence noted anteriorly over the femoral condyles. The patient was unable to perform a straight leg raise or any active range of motion (ROM) at the knee. Radiographs performed with the knee maintained in flexion confirmed that the patella was displaced into the knee joint and was rotated with the articular surface facing distally. Also noted was a coronal shear fracture of the lateral femoral condyle (**Figures 1A, 1B**).

The patient received pain medication and an intra-articular lidocaine injection prior to a reduction attempt by the orthopedic resident. With the patient supine, the hip was gently flexed to relax the quadriceps muscle. As the knee was flexed up to 110°, the prominent patella was gripped between the thumb and fingers to gently free and elevate the patella out of the intercondylar notch.

After reduction, an immediate return of normal patellar contour and patellofemoral tracking was observed as the knee was gently extended. There was no obvious defect to the patellar or quadriceps tendons, and the patient was able to perform a straight-leg raise, confirming the integrity of the extensor

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mechanism. Radiographs performed after the reduction confirmed relocation of the patella in correct anatomic position, as well as a lateral femoral condyle fracture (Figures 2A, 2B). Magnetic resonance imaging (MRI) of the knee confirmed no full-thickness quadriceps or patellar tendon tear. A computed tomography (CT) scan of the knee showed a comminuted fracture of the lateral femoral condyle in the coronal plane, as well as multiple bone fragments within the joint (Figures 3A, 3B).

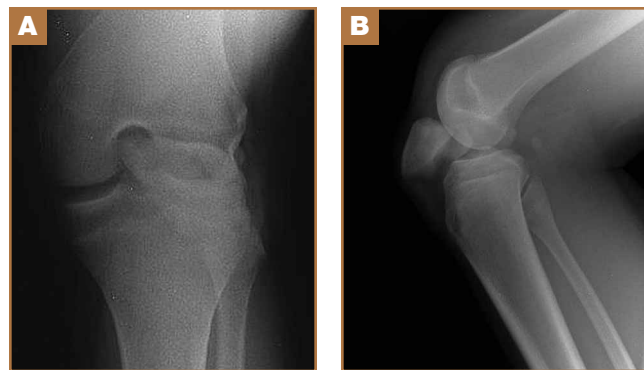


Figure 1. (A) Anteroposterior and (B) lateral radiographs taken at time of injury show intra-articular patellar dislocation and lateral femoral condyle fracture.

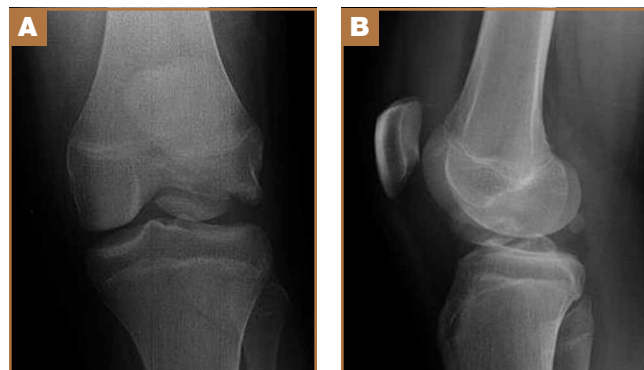


Figure 2. (A) Anteroposterior and (B) lateral radiographs taken immediately after reduction of patella show return of normal patellar position and displaced intra-articular femoral condyle fracture.

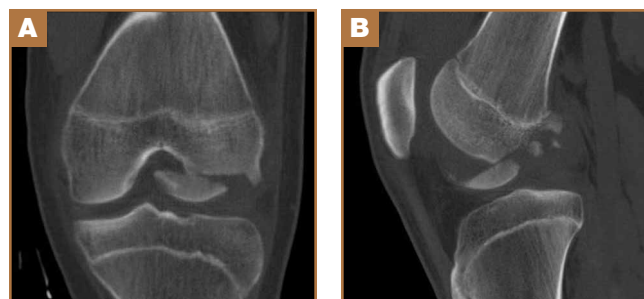


Figure 3. (A) Coronal and (B) sagittal computed tomography images show lateral femoral condyle fracture.

The patient was placed in a bulky soft dressing and underwent open reduction and internal fixation of the fracture.

A 10-cm incision was made over the anterior aspect of the knee, and after dissection to the level of the retinaculum, a lateral parapatellar arthrotomy was performed. The patella was retracted medially to identify and free the fracture fragments. The fracture fragments were provisionally reduced and stabilized with three 0.065-in Kirschner wires. An area of osteochondral impaction proximal to the fracture was elevated and allograft bone was incorporated below the articular surface (Figures 4A, 4B). Rigid fixation of the fracture was achieved using 3 screws (2 Bio-Compression Screws [Arthrex Inc., Naples, Florida] and 1 Synthes cannulated screw [Synthes, West Chester, Pennsylvania]). The screws were placed in postero-anterior (PA) direction and inserted into the weight-bearing articular surface of the femoral condyle (Figures 4C, 4D). The

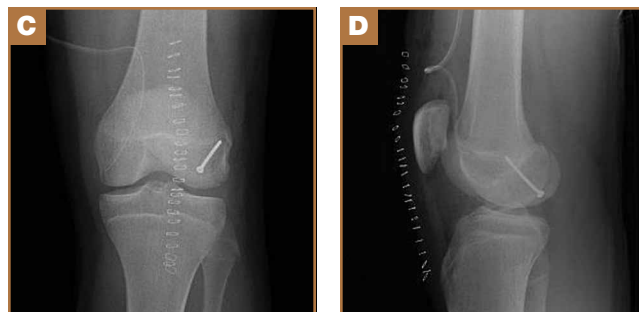
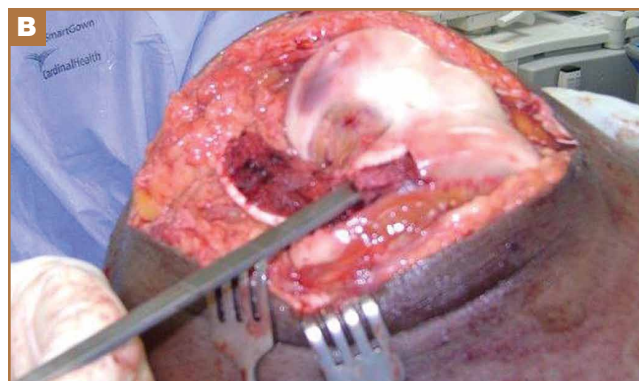
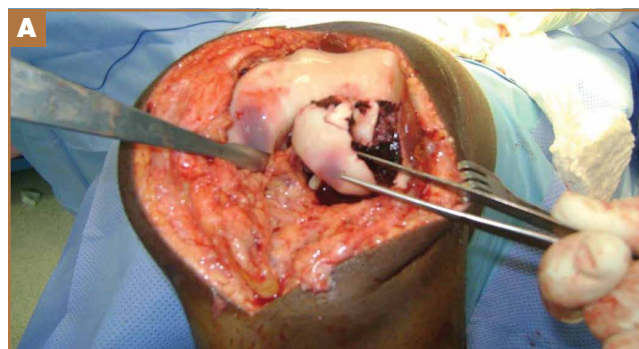


Figure 4. (A, B) Intraoperative photographs show osteochondral impaction and lateral femoral condyle fracture fragments. Post-operative (C) anteroposterior and (D) lateral radiographs show fracture fixation.

screws were countersunk, and stable fixation with compression of the fracture was achieved. Reduction and screw position were verified with fluoroscopic views. The wound was closed in layers, and the patient was discharged home the next day.

Postoperatively, the patient was non-weight-bearing on the affected limb with a hinged-knee brace to allow for knee ROM exercises immediately. He was also given a continuous passive motion device to maintain knee motion. At the 6-week mark, the patient's fracture alignment appeared to be well-maintained and showed interval healing. Clinically, the patient was noted to have limited knee ROM. The decision was made to take the patient to the operating room primarily for a manipulation under anesthesia and resection of scar tissue from postoperative arthrofibrosis. Arthroscopic screw removal was also planned as a secondary procedure at the same time in order to prevent the possibility of chondral injury from screw migration. During the procedure, the patient was noted to have improved ROM from 5° to 85° premanipulation to 5° to 110° postoperatively. At 3 months after the initial injury, the patient was allowed to begin progressive weight-bearing on the left knee. At most recent follow-up, after 12 months, the patient was able to ambulate and bear weight on the left leg without pain. Plain radiographs show a well-healed fracture with no evidence of collapse of the femoral condyle (Figures 5A, 5B). His active ROM of the left knee was 5° to 110° without pain (Figures 5C, 5D).

Discussion

In the vast majority of patellar dislocations, the patella dislocates laterally over the trochlear groove. Inferior, or intra-articular, dislocations of the patella are rare. The mechanism of injury is usually a blow onto the patella with a flexed knee. The 2 groups commonly involved are adolescent boys and the elderly.^{8,9} In young men, it is thought that lax patellar attachments place adolescents at higher risk for this type of injury.¹⁰⁻¹² While patella fractures and frank extensor mechanism ruptures are uncommon in this age group, the same mechanism of injury can lead to stripping of the deep fibers of the patellar tendon from the superior pole of the patella.^{3,13} The intact superficial fibers of the tendon allow the patella to hinge and displace into the joint.¹⁴

Inferior dislocations of the patella are classified into 2 types based on the orientation of the articular surface and the presence of osteophytes.¹⁵ Type I inferior dislocations occur after a direct blow to a flexed knee forces the superior pole of the patella into the intercondylar notch. Type II dislocations are caused by osteophytes on the superior pole of the patella that become wedged in the intercondylar notch and dislocate the patella inferiorly. In type I dislocations, the patella is rotated in the horizontal plane and the articular surface often faces inferiorly, but type II dislocations do not involve rotation of the articular surface. Type II injuries are seen more commonly in the elderly.

Our patient was able to tolerate a closed reduction of the patella after an intra-articular lidocaine injection, and a successful reduction was achieved without great difficulty. However, the

majority of reports describe the need for an open reduction of inferior patellar dislocations.^{3,8} When closed reductions were a success, they were performed under general anesthesia or conscious sedation.³ It is thought that the difficulty of reduction results from the tension of the quadriceps muscle pulling the patella superiorly into intercondylar notch.^{11,16} However, successful closed reduction may be more likely in patients with less patellar rotation and entrapment within the intercondylar notch, as well as in patients whose knee is near full extension at presentation.¹⁷⁻¹⁹ Successful closed reduction is also seen in elderly patients, where dislocation is generally caused by less forceful impact and held by osteophytes. In these patients, the knee is commonly held in extension.^{12,15,20-22}

The fracture pattern seen in this case also shows a rare fracture in skeletally immature patients, with only a few case reports in the literature. Isolated coronal plane femur fractures

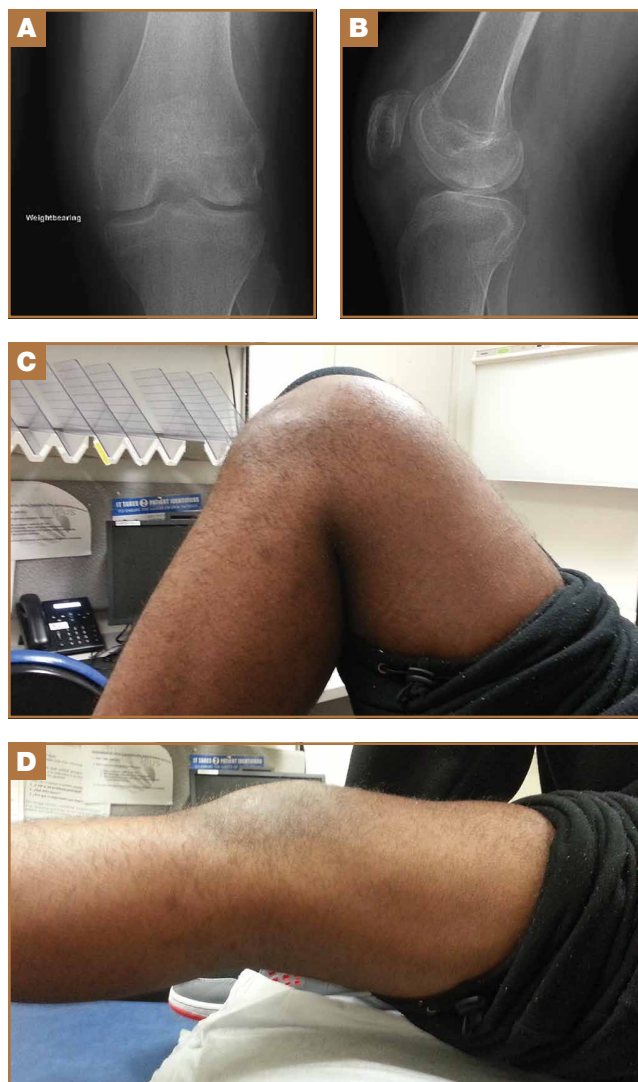


Figure 5. (A) Anteroposterior and (B) lateral radiographs at 12-month follow-up show fracture union. Clinical photographs of the left knee at 12-month follow-up in maximum (C) flexion and (D) extension.

account for 0.65% of all femur fractures and are usually seen in adults after high-energy trauma.²³ In the skeletally immature, the fracture can occur with lower-energy mechanisms. The typical mechanism is thought to be a shearing force to the femur caused by an axial load to the knee in 90° or more of flexion.^{4,24} A CT scan is recommended for better identification of the fracture and to plan treatment.^{25,26} Because of their intra-articular nature and tenuous blood supply, Hoffa fractures tend to do poorly with nonoperative treatment and are prone to displacement and nonunion.^{27,28} The goal of operative treatment is to obtain anatomic reduction and rigid fixation. While operative fixation techniques are varied, screw fixation with multiple smaller diameter screws has equal pullout strength compared to larger screws and may minimize damage to the articular cartilage.²⁹⁻³¹ By preserving blood supply to the fracture, and allowing for early active mobilization, operative treatment generally provides good long-term functional outcomes in these fracture patterns.²⁴

Conclusion

We describe a case in which the patella of an adolescent boy dislocated inferiorly into the knee joint, with an associated coronal shear fracture of the lateral femoral condyle. To our knowledge, this constellation of injuries has not been reported. For this uncommon injury pattern, we recommend a sequential treatment algorithm to minimize morbidity. We recommend first attempting a closed reduction of the patella with adequate pain control to avoid the morbidity associated with general anesthesia. After a successful reduction, an advanced imaging study (eg, MRI) is advisable to assess for concomitant soft-tissue injuries and preoperative planning, if necessary. The mechanism of injury and force required to cause a patellar dislocation of this nature leaves a high likelihood of other injuries. When a fracture is noted on plain radiographs after reduction, a CT scan can provide important information for planning surgical fixation of the fracture. Even in a skeletally immature patient, the principle of direct reduction and stable interfragmentary fixation of an articular fracture is critical for long-term function, even after a significant trauma to the knee.

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